

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2018/2019

EEE 7296 – ENERGY MONITORING AND AUDITING

26 OCTOBER 2018
10.00 a.m. – 1.00 p.m.
(3 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 5 pages including cover page with 4 Questions only.
2. Answer **ALL** questions. All questions carry equal marks and the distributions of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided. Draw the graph on the given graph paper.

Question 1

- a) What are the key steps involved in supporting energy management and their benefits?

[8 marks]

- b) Table Q1 (a) shows the dimensions of the first floor of a Software Developing Company. 80% of the floor area has been occupied. The company works from Monday to Friday a week between 9.30 am to 6.30 pm. The energy consumption data of the company are given in Table Q1 (b). Make use of the given formula, and compute the BEI (kWh/m²/year).

[17 marks]

Table Q1 (a) - Floor Dimensions

| Section | Length (mm) | Width (mm) |
|-------------------------------|-------------|------------|
| First Floor Overall Dimension | 50000 | 30000 |
| Common and Service Areas | | |
| Réception Lobby | 12000 | 8000 |
| Lift Lobby | 10000 | 8000 |
| Waiting Areas | 6000 | 6000 |
| Registration Area | 10600 | 6300 |

Table Q1 (b) - Energy consumption

| Month | Air-conditioner consumption (kWh) | Lighting consumption (kWh) |
|-----------|-----------------------------------|----------------------------|
| January | 10500 | 7100 |
| February | 11900 | 6200 |
| March | 11700 | 6950 |
| April | 18000 | 6200 |
| May | 14100 | 7750 |
| June | 13900 | 7300 |
| July | 14750 | 7550 |
| August | 13100 | 7900 |
| September | 14100 | 7400 |
| October | 12300 | 8900 |
| November | 11900 | 7500 |
| December | 12800 | 8700 |

Formula

$$BEI = \frac{(TBEC - CPEC - DCEC)}{(GFA - DCA - (GLA \times FVR))} \times \frac{52}{WOH}$$

Continued...

TBEC – Total Building Energy Consumption (kWh/year)
 CPEC – Carpark Energy Consumption (kWh/year)
 DCEC – Data Centre Energy Consumption (kWh/year)
 GFA – Gross Floor Area exclusive of car park (m²)
 DCA – Data Centre Area (m²)
 GLA – Gross Lettable Area (m²)
 FVR – Weighted floor vacancy rate of GLA (%)
 52 – Typical weekly hours of office buildings in KL/Malaysia (hrs/week)
 W O H – Weighted weekly operating hours of GLA exclusive of DCA (hrs/week)

Question 2

- a) The daily energy consumption data of an Aluminium Factory is shown in Table Q2 (a). The data were collected on Monday and Tuesday from 8.00 to 17.30 hours at every 30 minutes' interval. Assuming same production rate on both days,

- (i) Plot the graph for energy consumption (kWh) versus time on the given graph paper. Comment on the unit production cost on these two days, and

[11 marks]

- (ii) Analyze the data and give reasons for the hike in energy consumption. [4 marks]

Table Q2 (a)

| Time | 800 | 830 | 900 | 930 | 1000 | 1030 | 1100 | 1130 | 1200 | 1230 | 1300 | 1330 | 1400 | 1430 | 1500 | 1530 | 1600 | 1630 | 1700 | 1730 |
|----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Monday (kWhr) | 2300 | 2500 | 2600 | 2700 | 3400 | 5300 | 6740 | 6300 | 7800 | 6720 | 6930 | 6320 | 5800 | 5900 | 5530 | 4820 | 4790 | 3490 | 3390 | 2900 |
| Tuesday (kWhr) | 2300 | 2700 | 2540 | 2630 | 2900 | 4890 | 5760 | 5780 | 5600 | 5400 | 5900 | 5870 | 5490 | 5600 | 5270 | 5400 | 4600 | 3120 | 2950 | 2650 |

- b) For a Medium-sized Shopping Mall in Malaysia, the Energy Consumption data for two years are given in Figure Q2 (b). The Mall functions on all week days between 10.00 am to 10.00 pm. The head count of the visitors and the workers of the Mall are given in Table Q2 (b). Analyze the energy data and explain whether the Mall operates efficiently or not.

[10 marks]

Admin Block Electricity Consumption (kWh) in 2016 and 2017

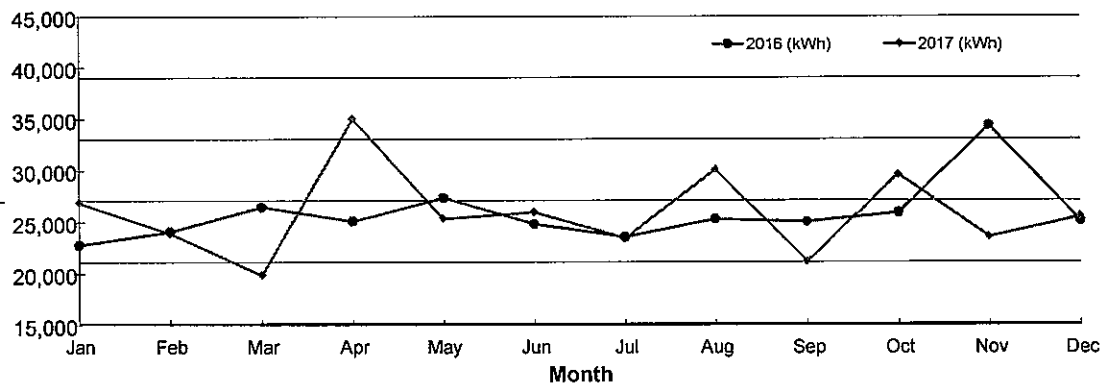


Figure Q2 (b)

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Table Q2 (b) - Number of Visitors & Workers

| Month | Number of visitors & workers | |
|-----------|------------------------------|-----------|
| | Year 2016 | Year 2017 |
| January | 1800 | 2000 |
| February | 2050 | 2100 |
| March | 2100 | 1100 |
| April | 2200 | 2300 |
| May | 2070 | 2050 |
| June | 2150 | 2100 |
| July | 2060 | 1980 |
| August | 2100 | 2010 |
| September | 2030 | 1870 |
| October | 2120 | 2050 |
| November | 2800 | 2010 |
| December | 2150 | 1980 |

Question 3

- a) What are the basic components of a well-organized audit report? Briefly explain each component. [10 marks]
- b) In an unbalanced 3-phase distribution system, the load draws 150 A, 180 A and 120 A from the three phases. Compute the extra power loss due to unbalancing. Assume the neutral wire has half the cross section of the phase wires and same power factor for each load. [5 marks]
- c) A small indoor stadium is to be illuminated by 10 HPMV lamps having each of 80 W rating. The other alternative is to replace the HPMV lamps with 10 groups of LED lamps having a 30 W rating for each group. Both the system produces same illumination. If the cost of the LED lamp is 2.5 times the HPMV lamp, compute the number of months after which excess cost of LED lamps will be compensated by the savings in the energy cost. Given the energy cost of RM 0.2/kWh, number of working hours per day is 6. [5 marks]
- d) A motor in an air-conditioner works on ON/OFF mode with 12 minutes ON and 8 minutes OFF period in each cycle. It draws a full load current at 0.9 pf during the ON period. To maintain the same temperature, the motor may also run continuously at a lower speed drawing 80% of the full load current at 0.8 pf. Compute the energy saving per day. [5 marks]

Continued...

Question 4

a) Briefly explain the working of the following Energy Audit instruments.

(i) Flue Gas analyzer

[5 marks]

(ii) Remote sensing thermometer or Pyrometer, and

[5 marks]

(iii) An ultrasonic flow meter

[5 marks]

b) A manometer connected to a pipe indicates a negative gauge pressure of 50 mm of Mercury. What is the absolute pressure in the pipe in Newton per square meter if the atmospheric pressure is 1 bar? [5 marks]

c) The filament of a 75 W light bulb may be considered as a black body radiating into a black enclosure at 70° C. The filament diameter is 0.10 mm and length is 5 cm. Considering the radiation, determine the filament temperature. [5 marks]

End of Paper